No. 143 November 2008

solplan review

the independent journal of energy conservation, building science & construction practice

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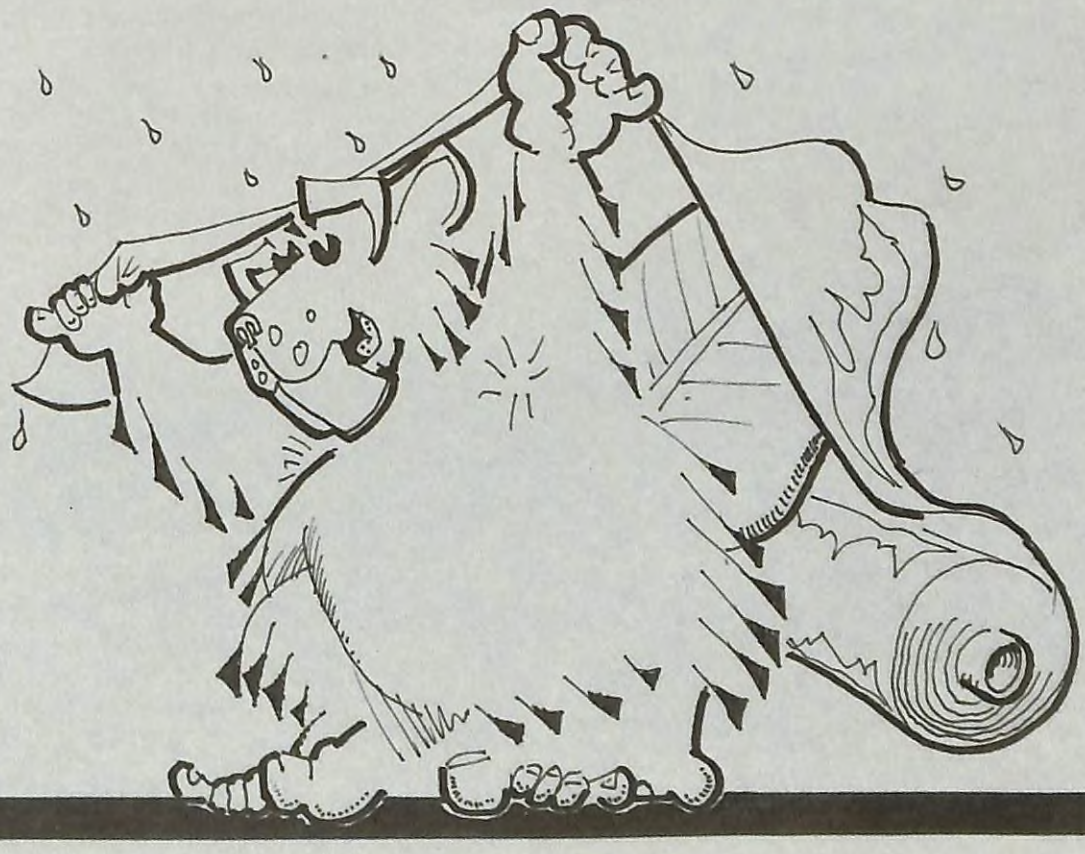
Vapour Barriers



From the Editor . . .

We have all heard the saying about living in interesting times. Interesting seems to describe our era. We are living in a time of phenomenal technological change, faster than we as individuals and as a society can absorb, yet few of us really appreciate the change we are living through. We certainly do not understand the impact of the many technological changes which are also having an impact on social structures, even how we interact with each other.

The proliferation of technology, such as cell phones, leads to the absurd. Recently I spotted a cartoon showing a couple exchanging wedding vows in front of a minister, each one talking into a cell phone, rather than directly to each other. Although the cartoon is meant to poke fun at how many of us have become addicted to new technology, it also shows how absurd it can become, when people call or e-mail rather than walking down the hall to talk in person.

There was a time we worked, played and talked with neighbours down the street and in the community, in person. Increasingly, we are becoming isolated, cocooned in our own private electronic bubble, interacting with others mostly through an electronic filter. While the wired world has opened many doors and tied the world together, making it accessible for everyone, it has also resulted in barriers.

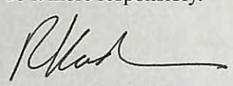
Increasingly we are seeing people afraid of meeting each other in person because we have such limited interaction on a regular basis in our daily life. Concerns about social deviants are rampant. Children are no longer allowed to walk to their neighbourhood school or play outdoors, but permitted to play on the Internet. Women are afraid to take transit. Seniors are afraid to answer the door. Young people have difficulty socializing because they grow up cocooned in their own electronic world, and then we wonder when a group of young people get out of hand at a public event, and we wonder about rising obesity rates.

Yet the way we lay out and build our communities today directly feeds into some of these concerns.

The environmental crisis we face is also a direct result of the technological changes. In the past, technical evolution took a more leisurely pace, so that impacts and consequences of decisions and changes could be properly evaluated. Today, we leapfrog technical changes before we understand the full impact or effect of previous changes. This is especially consequential in our industry because we build buildings that are going to last for many years if not generations.

We are now entering a period of difficult economic readjustment, but a contributing factor has been the fast changing technological world we live in. Political, economic and technical changes are being made with the aid of tools we don't understand. The financial system started being manipulated by automated decisions, as if it were another video game, to result in the chaos we see.

The treatment of houses as investment commodities rather than homes has led to a mindset that has fed a bubble that has burst in the US and Europe, and is showing its head in the major markets in Canada. This slowdown should be a time we re-evaluate what and how we've been doing things and take advantage of the time to put in place a solid foundation for improvements. This is the time we should be investing in research and training, so that when the economic recovery comes, it won't follow the wasteful business as usual path, but rather we'll have a better way to do it more responsibly.



Richard Kadulski,
Editor

solplan review
the independent journal of energy conservation, building science & construction practice

Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster
Contributors: Brian Toller, Elizabeth White, M.M Armstrong, John Burrows, HRAI Associates Link, Gordon Howell, Peter Amerongen, Rob Dumont, Janet Ansell
ISSN: 0828-6574
Date of Issue: December 2008
SOLPLAN REVIEW is published 6 times per year by:
the drawing-room graphic services ltd.
PO Box 86627, North Vancouver, BC V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@shaw.ca
Street address:
#204 - 1037 West Broadway
Vancouver, BC V6H 1E3

Publications Mail Agreement No. 40013363
Postage paid in Vancouver, BC.
Return undeliverable Canadian addresses to
PO Box 86627, North Vancouver, BC V7L 4L2
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Vapour Barriers:
or Vapour Diffusion Barriers

Moisture in the air is one the most important sources of wetness in buildings. It is essential to understand how moisture moves in, around and through a building envelope.

How moisture moves

Water can move in bulk, in the form of rain and sleet, or as water vapour. Movement of water in vapour form is very misunderstood. Water vapour moves through the building enclosure by convection and diffusion.

Air has a limited capacity to hold water, and the capacity decreases as the temperature drops. Condensation will take place when the warm air cools and encounters a cold surface.

Convection air movements move warmer moist air to colder regions so that the air can deposit its moisture on contact with cold surfaces. That creates many problems, and is a serious issue that must be dealt with.

Diffusion is the random movement of water molecules from an area of high vapour pressure (warm) to an area of low vapour pressure (cool). Vapour diffusion is a small contributor to moisture movement – air movement (air leakage) may move one hundred times the amount of moisture of vapour diffusion. Diffusion is not usually the source of severe moisture problems. While moisture movement by air leakage can be measured in terms of grams or litres of water, diffusion is measured in terms of nanograms (one billionth ($1x10^{-9}$ or 0.000000001 of a gram).

Air barriers do more than just control condensation. They also ensure better thermal performance, reduce sound transmission and help manage indoor air quality.

In walls insulated with vapour permeable insulation, and no vapour barriers, water vapour can diffuse through the insulation to the exterior where it can condense on the exterior sheathing. Condensation inside walls is a problem that can lead to rot, mould, corrosion and/or staining.

Measuring moisture movement

Calculating the absolute amount of moisture moved by air movement and vapour diffusion is difficult to do because of the number of variables, and is a topic for building science researchers to revel in. If there is enough condensation, and drying cannot take place, there can be a build-up of moisture.

Calculation of vapour flows is generally done following similar principles to heat flow. However, vapour movement calculations are not as accurate because vapour permeability not only varies with the vapour pressure differential, but also the moisture content and temperature of the materials. The moisture storage capacity of most building materials is so large that steady state conditions almost never occur in practice.

Not just a cold weather concern

Condensation has typically been considered a cold weather concern. However, problems have also been observed in above-grade walls where moisture was absorbed into porous non-vented claddings, such as wood, brick or stucco and driven inward to condense on the exterior side of low-permeance inner layers, such as polyethylene vapour barriers or other interior finishes in air conditioned buildings. This reverse vapour drive can be significant.

Condensation has also been observed in below-grade walls where inward drying of moisture, built-in construction moisture in concrete or from the soil, is trapped by low-perm vapour barriers.

Pros and cons of polyethylene

CMHC has had a research program studying the significance of potential moisture problems due to plastic sheeting used as a vapour barrier in above-grade and below-grade wall assemblies. The research was intended to identify cases where performance can be improved and changes made that could reduce inappropriate use. The research also looked at the benefits and risks with

Research shows the limits of what we know: both poly and no-poly walls are susceptible to moisture problems under some conditions. Neither is a panacea. Both have their uses.

Research also shows that below-grade, interior basement walls should avoid polyethylene vapour barriers.

polyethylene – the intent was to clarify in which situations it is necessary, potentially damaging, or unimportant to use polyethylene.

Contractors and inspectors have become familiar with details and practices required to achieve tight and reliable enclosures using polyethylene. Polyethylene vapour barriers have become a part of building codes and a standard practice in the Canadian construction industry, the result of substantial investment in research and training. Their use as an air barrier has resulted in significant improvements in building envelope air tightness when properly applied. However, concerns have been expressed that because of its low vapour permeance, polyethylene may reduce the drying potential and in the process trap moisture.

Vapour Permeability Values

Material	Water Vapour Permeability (ng/Pa.s.m^2)
½" foil backed drywall	Negligible
6-mil polyethylene	1.6 – 5.8
1" Foil-faced polyisocyanurate	4.3
1" paper-faced polyisocyanurate	61
¼" (6.4 mm) plywood	23 – 74
50 mm reinforced concrete	23
9.5 – 18 mm plywood	40 – 57
OSB	44
1" (25 mm) extruded polystyrene	23 – 92
1" (25 mm) 2-pound (closed cell) spray foam	96
Painted (1 coat primer, 2 coats latex)	180
1" (25 mm) expanded polystyrene (beadboard)	86 – 160
½" gypsum board (uncoated)	2600
10 minute Asphalt paper	370
30 minute Asphalt paper	650
Brick	102 – 602
Stucco	75 – 240
1" (25 mm) ½ pound (open cell) spray foam	3790
Spun bonded polyolefin membrane	3646
Note: Vapour permeability is difficult to measure accurately and is highly sensitive to small changes in the material.	
Permeability is also dependent on material thickness e.g. thicker foam insulation will have a lower permability	

There is no definitive consensus about the maximum vapour permeance for the interior of Canadian walls to reduce cold weather diffusion problems. Recommended values in research documents vary considerably, and vary with exterior climate, wall assembly construction details, and interior humidity conditions. While there is little doubt that a layer with the vapour permeance of polyethylene sheeting will control winter diffusion, there is considerable debate about how low the permeability must be. The Building Code has set a somewhat arbitrary cut-off target of 60 ng/s.m^2.Pa as the definition of a vapour barrier.

In general in Canada, the vapour flow will be from the inside to the outside. That is why vapour barriers are used on the interior, but in mild climates, especially in air-conditioned buildings, the vapour drive could be to the interior at some times of the year.

Vapour diffusion is also the main way that moisture in a wall assembly can escape, so that vapour barriers can also prevent drying.

Problems have been noted in basement walls because they are always damp on the exterior, so inward drying of construction moisture in the concrete foundation walls and framing lumber is prevented and the moisture is trapped by the polyethylene on the interior. In such locations, drying could take place into the interior if there is no vapour barrier.

The CMHC research points out that moisture issues could arise in some situations with low or high permeance interior vapour barriers. The research gives guidance on the situations where polyethylene sheeting is or is not a problem, and regarding appropriate vapour permeance levels for walls in different geographical areas.

The research has been useful to show the limits of what we know. Both poly and no-poly walls are susceptible under certain conditions. Neither is a panacea. Both have their uses.

Vapour barriers tested

Full-scale above-grade wall samples were tested at the University of Waterloo. The test conditions were extreme conditions with a year-round indoor relative humidity of 50% (much higher than will ever be encountered in a typical home) in order to create conditions for outward diffusion. Four interior insulated basement wall assemblies were also built into a house in Kitchener, Ontario.

The testing confirmed the need for an air barrier in all walls. If plastic sheeting (used as an air barrier) is removed, then other measures/systems/materials need to be used to provide the air-tightness.

Above grade walls

The monitoring of the above grade wall assemblies with and without polyethylene (and without extruded polystyrene insulation) showed high humidity conditions in the wall cavities and potential condensation problems. The wall assemblies with polyethylene had higher summer moisture contents and lower winter/spring moisture contents than those wall assemblies without polyethylene.

Summertime condensation is of concern for moisture damage of walls because it occurs during a time favourable to microbial growth. On the other hand, wintertime condensation on the sheathing occurs when temperatures are less likely to allow mould growth. Damage then becomes a function of how quickly drying occurs relative to the onset of warmer temperatures.

The assemblies without poly did not have any form of vapour diffusion control – just regular latex paint on drywall. However, a second year's monitoring with the use of a vapour barrier paint showed lower moisture conditions.

In walls with polyethylene, there had to be special conditions, such as an absorptive exterior cladding without a rain screen for there to be conditions favourable for condensation on the outboard face of the polyethylene in the summer.

Although extruded polystyrene insulated sheathing can control summertime inward vapour diffusion, it must have enough thickness to reduce wintertime condensation when no interior polyethylene or low permeance paint is used. Modelling suggests that with normal interior conditions, condensation risks can be controlled with an interior low permeance paint in all geographic locations reviewed.

By removing interior very low permeability layers that have traditionally been relied upon as a vapour barrier, moisture can escape to the interior when vapour drives are in this direction.

Where low vapour permeability interior finishes (such as vinyl wall coverings) are employed in lieu of plastic sheeting or accidentally in walls without plastic sheeting, moisture may accumulate within the interior drywall (Building Research Establishment 1989).

Basement Walls

Only south walls that received sunlight or that were partially shaded were monitored, as these would see the highest variation in moisture movement conditions over the year.

Although there was evidence of moisture movement in several of the walls, evidence of mould was limited when the wall was opened. Walls with and without polyethylene had moisture levels within acceptable limits. The wall without polyethylene had higher moisture content in the wood framing at the above-grade wall section in winter, but it was within safe limits. The wall with polyethylene had generally higher moisture content, demonstrating the effect of eliminating moisture drying to the interior.

Measurements showed summertime inward vapour drives at the above-grade portions of the walls. Condensation was seen in walls with an interior polyethylene vapour barrier, and correlated to an inward thermal gradient. This is likely in climates with a significant cooling load (i.e., those with very longer hot summers).

Wintertime condensation was not a problem in

Inward vapour diffusion driven by solar heating of the exterior parts of walls has long been observed to cause damaging levels of condensation in Canadian walls.

- The incidence, severity, consequences, and significance of solar driven inward drives are not well understood.
- The factors that have been demonstrated or calculated to affect the quantity and significance of solar driven inward diffusion include the:
  - orientation to wind-driven rain and sun heating
  - absorptive and storage capacity of the cladding
  - presence of ventilation behind the cladding
  - vapour permeance of the sheathing layers behind the cladding
  - vapour permeance of the interior finishes
  - vapour permeance of vapour barriers
  - interior temperature

the monitored walls, with or without an interior vapour control layer. However, the temperatures of the above-grade portion of the basement wall were measured to be much warmer than would be predicted by a conventional analysis of a one-dimensional wall section. Perhaps this is due to the air space behind the insulation, permitting convection air movement on the cool, ground connected portion of the foundation wall. This will mean a much lower risk for wintertime condensation.

Simulations suggest that vapour control is necessary at the above-grade portion of the basement wall, but they do not capture the temperature phenomenon, and thus give overly conservative results. Modelling of the above-grade portion of basement walls suggest increasingly worse performance with colder climates, higher interior humidity levels, and increasing vapour permeance.

The below-grade sections of all four wall assemblies had moderate and stable humidity conditions.

The research suggests that interior vapour control at the lower portion of the basement wall is unnecessary or inhibits drying. These locations experience temperatures that are similar to geographic locations that require no vapour control layer. The monitored data shows that an interior impermeable layer below grade reduces drying and results in longer periods of elevated humidity at the concrete-insulation interface. Simulations showed that performance at the lower portion of the wall improves with higher vapour permeability. Instead of a vapour barrier, the study results suggest that an air barrier might be all that is required to control condensation in the below-grade portion of the basement wall.

Code officials should be informed about the results, as changes to codes and construction practice are likely. Permeability in the below-grade portion of the basement wall can be advantageous and should be explored further.

The results on the interior below-grade, basement walls suggest that we should be avoiding polyethylene vapour barriers in that application. A field research project is underway to confirm the test finding by monitoring of several occupied houses. However, that research will probably not be ready for a couple of years.☼

Letter to the Editor

Re: Good Basement Detailing (Solplan Review 142, Sept. 2008)

I would like to thank you for providing our industry with an in-depth detailed publication that is full of important information that helps each and every contractor that reads your detailed reports with in the Solplan Review.

I always read the magazine thoroughly. I have been receiving it since it was established. All in all it is very informative. All articles have merit and can be applied to all applications when in need.

However, I have a concern with the article on basements and basement detailing, especially the way you describe the framing of the exterior basement walls. I am not a scientist but I can attest that the diagram you show for basement wall framing doesn't work and is not a durable system.

The way we have been doing it has worked well for us. We keep an air space between the foundation wall and the interior furred wall which allows the foundation wall to breathe. We prefer to use metal studs not wood studs. We use a 3 5/8" metal stud, which allows us to have continuous R-12 insulation. The stud cavity is uniform, so there is a constant R-value without the thermal break that wood framing creates because compared to the wood stud, the metal stud has no thickness and allows the insulation to be continuous within the wall assembly.

The insulation is also installed in the header part of the floor joist space where the wall system meets the underside of the floor joists. We install 6-mil vapour barrier over the steel studs and the header area with an acoustical sealant and at the metal track/plate at the floor area. We ensure a continuous seal of the vapour barrier at all penetrations including the electrical boxes.

Access panels are used to gain access to the water line clean outs and shut off valves. When one of these panels is opened, you can feel the air flow in the cavity, which is what we want. A continuous air flow on the cold side of the wall assembly allows the foundation wall to breathe.

We have seen our basement system work for more than twenty years, so it tells us our method of construction practice stands up to the test of time in this area. We have done more than 400 basements over the past twenty-plus years. Even building inspectors have given us rave reviews on how our construction practices have worked over the years.

Food for thought: concrete is porous and needs to breathe. Trapping moisture only holds it for future problems. Water doesn't go up, it goes down and mould doesn't grow in light it grows in the dark!

Darren Onyshko
Burlington, ON

Thanks for the comments. Good basement detailing is important. Although the basic building science principles are the same, what works in some regions may vary due to local practices and site conditions.

Your description of the basement wall details you use is one that is commonly used by builders across the country, and is code compliant. However, the detail you describe raises a number of issues. Because you use steel furring, it will not suffer from biological action when or if condensation happens. Although the steel studs may have a thin material section, and the full cavity can be insulated, the effective insulation value of the wall is not as good as one may think. The thermal bridging through steel is much worse than through wood.

A calculation using HOT-2000 shows that a 2x4 steel furring wall with R-12 batt and drywall interior against a concrete basement has an effective value in the range of R-3.36, while a 2x4 wood furring wall is R-10.07. Although the calculation was done using a specific house file, the relative order of magnitude will remain the same. That is why steel framing standards require that foam insulation must be installed on the exterior to deal with thermal bridging issues.

The breathability we often talk about really relates to the water vapour permeability, not actual air movement. (See the item on vapour barriers.) While air movement will help remove moisture if conditions are right, we should always consider where the moisture is coming from and to where and how the is moisture going. Under some conditions it could be doing more damage than good.

You mention being able to feel the airflow when the wall is accessed. The kind of airflow you notice could actually be a severe problem during some times of the year.

A good example of a 'breathable' foundation wall system is an ICF (insulated concrete form) system. The vapour permeability of the foam is greater than poly, yet it does provide vapour diffusion resistance, and provides an airtight system. One never uses poly in the ICF wall. Ed.

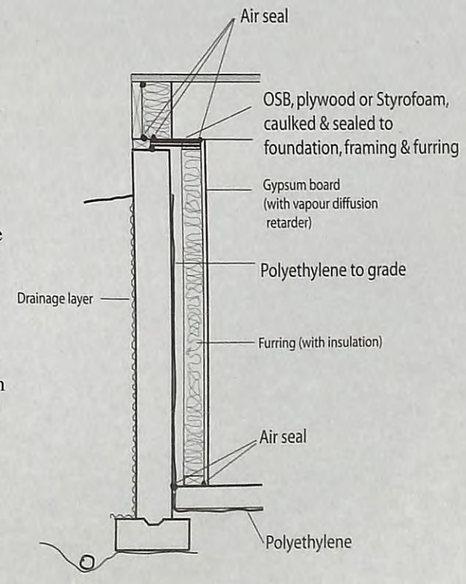
Basement Detailing

The fundamental principles that must be always addressed when considering basement construction are:
- site moisture management, including site drainage;
- introducing capillary breaks between soil and foundation;
- allowing site moisture to drain away from the foundation;
- achieving an air tight assembly;
- managing vapour diffusion in either direction.

John Hockman from Winnipeg provided us with a detail that they have found useful, both for renovation work as well as in new construction (see detail). They have found that the best way to detail the basement wall – and in particular maintain the air seal in the furred wall – is to use a solid panel, (either OSB, plywood or rigid insulation) to bridge between the top plate of the furred basement wood wall and the sill plate. All contact points are then carefully sealed.

The key point is to ensure that the space behind the insulation is air sealed at the top so there is no air movement between the gap behind the insulation and the floor framing above.

Where practical, rather than maintain an airgap between the furring and concrete, a layer of rigid foam insulation would be better, as it reduces the potential for convection air currents in the space.☼



Green Building: Energy Efficiency Standards

The renewed interest in green building technologies is being driven by a concern about dealing with climate change as well as fast-rising energy costs. As a result, we are seeing a proliferation of new low-energy home and green building programs.

Energy Efficiency Labelling Standards	
All provinces	**EnerGuide Rating System** This is a rating tool designed to measure a home's energy efficiency. There is no minimum EnerGuide rating requirement. Minimum EnerGuide rating for an R-2000 house is 80.
British Columbia	**R-2000** **Built-Green™ British Columbia** (this is a tiered standard – Built Green Gold requires EnerGuide 77, Platinum 82) **Power Smart New Homes** (Silver requires minimum EnerGuide 77 rating; Gold minimum 80)
Alberta	**R-2000** **Built-Green™ Alberta** (this is a tiered standard – Built Green Gold requires EnerGuide 77, Platinum 82)
Saskatchewan	**R-2000** **ENERGY STAR for New Homes** (minimum EnerGuide 80 rating)
Manitoba	**R-2000** **Power Smart New Homes** (requires minimum EnerGuide 77 rating)
Ontario	**R-2000** **ENERGY STAR for New Homes** (minimum EnerGuide 80 rating)
Quebec	**R-2000** **Novoclimat** (minimum EnerGuide rating 80)
New Brunswick	**R-2000**
Nova Scotia	**R-2000**
Prince Edward Island	**R-2000**
Newfoundland & Labrador	**R-2000**
Yukon	**R-2000** **GreenHome** program (minimum EnerGuide rating 80)
Northwest Territories	**R-2000**
Nunavut	**R-2000**
A number of provinces have signalled their intention to upgrade energy efficiency standards in the next 2-3 years to an equivalent performance level to that of Energuide 80.	

The R-2000 program, the granddaddy of high performance standards and a template used worldwide, is about to be updated with a much more rigorous energy performance standard.

The Built Green™ program in Alberta and BC has seen a strong uptake, with the result that builders are pushing to upgrade the top level. In Saskatchewan and Ontario, the Energy Star programs (based on R-2000 norms) have been introduced and are experiencing a renewed surge of interest. In Quebec, the program is known as NovoClimat. The table lists the main standards in each province.

Beyond these standards, there are local standards that have been developed specifically for a local jurisdiction – some are voluntary, others mandatory within the jurisdiction.

A new program that is to be launched in 2009 is the Canada Green Building Council's LEED for Houses program. This is a program that is based on the US Green Building Council's homes program. It is presently in the review and translation stage to adjust the standard to Canadian standards and conditions. Like most programs, this will be a voluntary certification program.

One thing all these standards have in common is a set of technical criteria that covers energy efficiency and environmental issues, although they may differ in how stringent the mandatory criteria are. The origins of most programs are energy efficiency. Newer programs have been adding environmental and resource efficiency criteria. For many people, it is the 'green' features that have attracted attention today with energy efficiency being downplayed, yet the energy performance represents the most important long-term impact of buildings.

Concerns have been expressed that some local jurisdictions are writing, or planning to write, one or more of these programs into their regulations, making compliance with the standards mandatory. One thing that is acknowledged by all is that these standards have been developed as market transformation vehicles, with the intent of improving housing stock by voluntary means. When criteria are mandated, they become something that must be followed by everyone, which imposes challenges and liabilities on regulators as well as builders.

Voluntary programs often include criteria and protocols that do not readily translate into mandatory regulations, and are difficult to administer when everyone needs to follow them.

These energy efficient, green standards evolved out of pioneering work done in the 1970s. One of the highest profile landmark projects was the Saskatchewan Conservation House built in Regina in 1980. This was quickly followed by many other, somewhat lower profile, demonstration projects in other regions. We profiled Provident house in King City, Ontario in Solplan Review (No. 141, July 2008).

One of the challenges is that after the flurry of ribbon cutting, and perhaps a few academic presentations following a year or so of performance monitoring, the projects fade from memory. If the homes did not perform as expected, the embarrassment factor sets in, and one doesn't hear much more about them. Sometimes, the lessons to be learned are precisely what went wrong or what did not work out as expected. Lessons learned from the projects may at best be remembered by the few directly involved in the project, and are quickly forgotten, yet the real lessons learned may only come after a few years or more.

The renewed interest in low energy homes, and net-zero or EQuilibrium homes is once again bringing up ideas for new technologies, some of which may have been tried in the past, but with the passage of time, have been forgotten. Although in theory the ideas sound interesting, in practice they may not perform as expected. That is why we are planning to go back to some early pioneering projects that may still be accessible, to see how they work after the passage of time, and what lessons could be learned.

Going back to early projects is important because we are seeing that, with the demographic shift, many of the early pioneers and others who've been involved over the years, are beginning to retire, so there is a loss of memory around some of these projects. Even though there may be project reports on some, they were all written in the pre-Internet era, and paper copies are tucked away in back corners of libraries and storage rooms, forgotten and gathering dust.☼

R-2000
For information on the R-2000 Program, contact your local program office, or call
1-800-387-2000
www.R-2000.ca

Allen-Drerup-White's 1981 Ottawa Energy Efficient House

A Canadian pioneering design-build company working in southern Quebec and Ontario in the late 1970s and 1980s was Allen-Drerup-White. Although the company has long since disbanded, the principals have remained active in the building, energy conservation and environmental fields. Following up on building conservation research in Saskatchewan and other regions, and applying their collective creative abilities, they built a number of innovative homes in Ontario and Quebec. The prototype of the Advanced Houses of 1993 was their Brampton Advanced house, built in Brampton, Ontario in 1990. Each was not only energy efficient, but designed to optimize passive solar energy gains, as well as try innovative techniques.

How well do these houses work? Have they stood the test of time?

One of Allen-Drerup-White's houses was built in 1981 in Ottawa. It is still occupied by the original owners, for whom it was custom designed. In October I had the opportunity to visit the house and talk with the owner. The house was designed to maximize passive solar gains and reduce energy demands. The building envelope was designed to be very efficient and reduce heat losses.

Roof insulation was R-60 loose fill cellulose insulation.

The exterior walls are 12 inches thick with R-50 insulation. The wall framing was essentially conventional advanced framing, with a continuous polyethylene wrapped on the outside of the sheathing as a combined air and vapour barrier, so that all interior services could be installed in the normal manner and contained within the framing, inside the air barrier. On the outside, there was stand-off framing

which was filled with loose fill cellulose. The weather barrier on the exterior was Tyvek house wrap, and the siding was wood. The foundation was pressure-treated wood.

The interior frame wall had fibreglass batt insulation. The rationale for the two types of insulation was a concern at the time that loose fill cellulose might compress over time, resulting in significant air pockets and loss of insulation at the top of the walls.

Windows were oriented for maximum passive solar gains. High performance windows were not available at the time, so all are clear glass, multi-paned units. On the north, east and west side, the window areas were kept modest, and were triple-glazed wood frame windows.

The south side windows are double-glazed Pella wood windows with removable interior storms. These windows are not airtight, and suffer condensation – they can't cope with normal house humidity in the winter. Fogging often starts in mid October, when outdoor temperatures drop below 8°C. In addition, small insects can get into the interior space between the panes. The hardware for the larger windows is inadequate, and makes closing and sealing the windows difficult to do.

While the large south facing glazing is very effective at providing passive solar heat gains to the house, the owners note that a major design oversight was a lack of attention to possible overheating. Looking back they feel more attention should have been given to cooling loads. There are no south facing overhangs on the house and even though there are deciduous trees, they are far enough away from the house not to provide adequate shade so there is overheating in summer. Ten years after construction, a small (2-ton) cooling system was installed.

The house has an open floor plan, built around an open staircase, which is lit by the sun and skylight. This helps collect solar heat, and also makes a large portion of the solar gains and heat from a small wood stove available directly to all parts of the house. The mechanical system is a combination system – the heating is fan coil for forced warm air heating that is supplied by a gas-fired boiler, which also provides domestic hot water. The original pulse boiler was replaced after 23 years. There is also a solar domestic hot water system that preheats water.

A modestly sized, rock storage bin (roughly 6'x8'x8') was built into the crawlspace, under the entry foyer on the north side. The insulated bin is charged by excess solar heat gain during the day. When heat is called for, and the rock store can supply heat, air is drawn through the rock store into the fan coil. The rock storage does an effective job during shoulder seasons (spring and fall) charging during the day, releasing heat in the evening – but there is not much heat storage capacity to store heat for a long period and into winter.

The mechanical system turned out to be too complex for maintenance. There were no system diagrams or specs left for the owner when maintenance was needed. To make matters worse, the system controls were placed in a discreet, out-of-the-way place – so out of the way that service folks had a hard time finding them. The owners eventually found a technician who was able to figure out how the system was intended to operate, and recreated a schematic diagram after the fact and labelled all components to make it easier to service.

The solar domestic water panels failed after about 18 years, due to corrosion. When they failed, the house operated without solar for about three years. The delay in replacement of the solar water system was largely because the steep roof pitch and high location for the solar panels made it difficult to get someone to replace them. Service technicians were not keen on accessing the roof to service and replace the panels. During the time the house operated without solar, the owner noticed that energy bills went up about $300-400 per year. The solar system has since been replaced.

How does the house perform after more than 25 years? The annual energy bill (for space heating and hot water) for the 2,900 sq.ft. Ottawa house today is in the range of $600-700 per year. The owners are still very satisfied with their home, and remark how comfortable it is. Although they are now empty-nesters, they have no intention of giving up the home they have found so comfortable, and efficient to operate.☼

Technical Research Committee News

Canadian Home Builders' Association

Oil Furnace Energy Star

The US Environmental Protection Agency (EPA) has set the minimum level for oil furnaces required to qualify for Energy Star at 85% AFUE. The same levels apply in Canada.

Proposed Home Energy Rating Act - Ontario

A private member's bill was introduced in the Ontario Legislature that would mandate the adoption of an Energy Rating System and the performance of an Energy Audit. This would apply to detached and semi-detached homes and low rise multi-unit residential buildings. Under the proposed bill, home energy ratings would be mandatory for new homes in 2010, for resale homes in 2011 and for leased homes in 2012. The objective of the bill is to protect Ontario's homebuyers and encourage the construction of more energy efficient homes and retrofits.

Universal ECM Retrofit Motor Introduced

Motor manufacturer Regal-Beloit recently announced the availability of a universal Electronically Commutated Motor (ECM) aftermarket motor for residential heating and cooling applications. This provides the opportunity for mechanical contractors to replace existing less efficient PSC motors with a high-efficiency ECM model.

More information: *www.evergreendealer.com*

Will Homeowners Spend Money On Eco-Friendly Renovations?

The Royal Bank of Canada's 5th Annual Renovation Study conducted by Ipsos Reid in August found that 60 percent of Canadians will include green options when revamping their homes and, of those, 30 percent say improved energy efficiency is among the primary reasons for their renovations plans (up from 14% in 2007). However, most (76%) say that they would do so only if it saved them money in the long run. Only eight per cent of Canadians would choose environmentally-friendly improvements if it cost them more and did not necessarily save them money in the future.

Many Canadians also hope to profit from their eco-renovations, as 76% said they believe ecological improvements would increase the value of their homes. Of those who did, 61% said installing solar panels would increase the value of their homes the most. Replacing windows (67%) and installing a high efficiency furnace (64%) were also popular renovation choices.

Homeowners are open to the idea of taking additional steps to reduce their homes' carbon footprint. Canadians are intrigued by the idea of living "off the grid" – that is, living in a self sufficient manner without reliance on public utilities – and a majority (51%) say they would actually consider such a change.

RBC found that the concept of a "net-zero" home appears to be even more appealing to Canadians, as two-thirds would consider green options that would enable their homes to produce at least a much energy as they use. More than half believe a "net-zero" home is a possibility for their current home over the next five years, and 71% believe this to be true in the next 10 years.

64% would consider having an environmental audit done before renovating to help them better understand how to reduce energy usage. This is no surprise, considering homeowners are reporting a 16% increase in their monthly energy bill compared to the previous year.

The Royal Bank is a sponsor of the Now house, one of the first Equilibrium demonstration homes recently completed, which is featured prominently in RBC print advertising.

In their own survey, the TD Bank found that the majority of Canadians are environmentally conscious when purchasing a new home or renovating their home. The biggest incentive for those willing to spend more on environmentally friendly features is the potential saving on future energy bills (65%)

The TD survey suggests that despite a slowing economy, two-thirds of Canadians are willing to pay more for a home that includes greener features. This number is down only slightly from 2007, which shows that even when times are more difficult, the environment is still important to Canadians. 57% of Canadians are willing to

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association, Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca
www.chba.ca

spend 5 to 10% more on a home with environmentally friendly features.

Although improving the state of the environment is an important factor, Canadians say that what matters most when renovating a home is saving money in the future (40%) followed by the resale value of their home (32%).

The poll found that almost all Canadians are making their current homes more environmentally friendly. 91% of the people have made improvements or will be making improvements in the next 12 months. The top improvement to make their home greener is replacing regular light bulbs (70%), followed by applying weatherstripping and caulking to stop drafts (52%) and replacing, upgrading windows (51%).

Seventy-seven percent have made or plan to make three or more improvements this year. Canadians aged 55 plus are taking the most action when it comes to environmentally friendly home improvements. Nearly all Canadians feel that the government should create initiatives to make residential construction greener. 91% of Canadians agree with environmentally friendly changes being brought into building codes for new buildings and 82% agree with building code changes for renovations. Canadians are less likely to agree with government initiatives if they directly have to pay for them. Sixty-eight per cent of Canadians disagree with a carbon tax for "non-green" homes.

The TD poll found that two-thirds of Canadians would consider an environmental assessment prior to finalizing their renovations plans. Of those willing to consider an environmental assessment, 51% would pay less than $400 for the assessment while one-third would like the assessment to be free.☼

Edmonton's Riverdale NetZero Energy House

The Riverdale NetZero Project in Edmonton is the most northerly (53˚32' North) EQuilibrium™ project. It is one of the winning entries in the first round of CMHC's EQuilibrium™ Sustainable Housing Initiatives.

The Riverdale NetZero Project is a semi-detached duplex built on an inner city site in Edmonton, Alberta. Each unit is about 2,500 sq.ft. (including basement). The builder-developer is Habitat Studio & Workshop Ltd, working in association with Solnorth Engineering Ltd., Howell Mayhew Engineering Inc., and a team of 40 Edmonton-area experts. The house was designed with a goal to surpass the net zero energy target. This was done by aggressively reducing energy consumption for space heating, water heating, lighting and appliances.

The steps used by the Riverdale NetZero house team to achieve its EGH rating of 100 were as follows:

- Energy efficiency of the building envelope itself – achieves an EGH rating of 86
- Electrical efficiency and passive solar heat gains – 93
- Active solar space and water heating – 96
- Solar electricity – 100+

Note that CMHC and NRCan developed a modified EGH index for the EQuilibrium houses in order to accommodate reduced electricity consumption by occupants in these houses.

By comparison, typical Alberta houses built in the 1990s have EGH ratings of 62 to 65, while those built in the 1970s have EGH ratings of 55 to 58. A Built-Green™ Gold is a minimum 77, Built-Green™ Platinum is 82, while R-2000 is at least 80.

At winter design conditions (-32˚C), the house heat loss is 22,400 BTU/hr.

The extra costs are not insignificant, but from the extensive modelling done for this project and the lessons learned from construction, the builder sees some of those costs coming down for the next net zero houses that they will build. Pricing for each unit of the duplex has not been finalized, but each is expected to go for $690,000.

Building Envelope

A key feature of the house is the energy efficient building envelope with very small heat losses.

The basement floor has 6" of Type 2 expanded polystyrene foam under the slab (R24).

The basement walls use a combination of 1" Type 2 expanded polystyrene foam, 2" polyisocyanurate board insulation and 9" of loose fill cellulose insulation in 2x4 furring for a total R-54.

The rim joist areas on both floors are insulated using blown cellulose for R-50.

Exterior walls on the main and second floors are built as a double 2x4 wall and filled with blown cellulose fibre insulation with a total thickness of 16" for R-56.

The ceiling cavity is insulated with 27" of blown cellulose insulation for R-100.

All windows have low-e glazing, insulated spacers and argon gas fill in insulated fibreglass frames. North-facing windows are quad glazed, while south-, east- and west- are triple glazed.

Solar Technologies

Three solar energy technologies are used in the house: passive solar space heating, active solar water heating, and solar electricity. All are off the shelf.

The passive solar heating system consists of 182 sq.ft. of south-facing windows, which is about 10% of the floor area. These maximize the amount of solar heating produced in the winter, capture solar energy reflected from the snow, and minimize summer overheating. These windows also have overhangs to minimize summer overheating. The house also has about 20,000 kg of thermal storage mass to store heat.

The active solar heating system consists of 7 solar heating collectors (234 sq.ft. in area) vertically above the widows plus two pumps, controls, three heat exchangers, piping, a 300 litre tank for domestic water heating and a 17,000 litre cistern in the basement for space heating. It heats water for both household domestic uses and space heating and is expected to generate some 4,100 kWh of heat per year.

Each unit has a 5.6 kW grid-connected solar photovoltaic system, which generates around 6,800 kWh of electricity annually. It consists of 28 solar electric modules (350 sq.ft. in area) at 53° on the roof, a DC to AC inverter, and a combination DC/AC switch. The system feeds directly into the house electrical panel. There is no battery bank.

One of the initial findings from the house at this time is that the solar electric system generates energy at a slightly cheaper price than the solar thermal system. This surprising result is because the solar electric system can feed as much energy as it can generate back onto the grid and so is very simple, while the solar thermal system has to store its own heat and so becomes quite a complex system.

All EQuilibrium™ homes will be open for public and professional audiences for demonstration, and then monitored for performance by CMHC for one year, once occupied. The interest generated by the Riverdale project can be seen by visitor numbers - on a single day in October they had more than 1,400 people come through the house, and have shown the house to 6,000 during the construction process. Because of this interest they've started their second net zero energy home and are planning their third for next year, both for private clients.

More information: *www.riverdalenetzero.ca.*

Solar DHW Standard

CSA F383-08, Installation of Packaged Solar Domestic Hot Water Systems is now available. This standard specifies requirements for the installation of packaged solar domestic hot water systems that meet the requirements of the CSA F379 Series.

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NRC·CNRC

Window Glazing Study at CCHT Shows Good Results

By M.M. Armstrong and John Burrows

National Research Council researchers recently compared the performance of high solar heat gain (HSG) glazing and low solar heat gain (LSG) glazing at the Canadian Centre for Housing Technology (CCHT). The studies, conducted in the side-by-side twin houses of CCHT, assessed the impact of the two window glazings (Figure 1) on energy consumption.

Previous studies had shown that in a typical Canadian house with conventional double-pane, clear-glass air-filled glazing, solar gain provides 10 to 27% of the total heating energy for the house. However, during the heating season, the same windows may account for more than 27% of the heat loss. The CCHT experiments sought to determine the best type of low-e glazing to achieve best year-round energy performance. The experiment showed that differences in the way the two different glazings managed solar gains had a much larger influence on the energy performance of the house than the small differences in their insulating values (U-factors).

Following the study, project partners at Natural Resources Canada used the results to benchmark computer models which were used to predict the energy performance of the two types of low-e glazing for ten locations across Canada. The models compared the performance of the HSG and LSG low-e argon-filled glazings with that of clear glass, air-filled (conventional) glazing. The calculations took into account the climate, the cost of heating and the cost of cooling in the various locations.

While both the LSG and HSG glazings provided energy cost savings compared to conventional glazing, the HSG window produced the best overall energy cost savings for all the Canadian locations based on the modeling calculations. The HSG glazing would be expected to produce between 13 and 17% savings in combined heating and cooling costs, while the LSG glazing would produce savings between 8 and 10%. Savings depend largely on the climate, the type and cost of fuel used for heating, and the distribution of the window area by orientation in relation to sun exposure.

M.M. Armstrong is a research council officer in the Building Envelope and Structure program at the NRC Institute for Research in Construction.

John Burrows is an Ottawa-based consultant and technical writer.

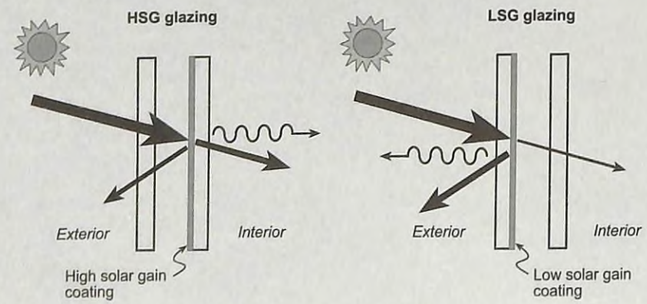

Figure 1. High solar heat gain (HSG) and low solar heat gain (LSG) glazing

Review of Findings

The project generated useful information to guide users in selecting the appropriate type of low-e coating to obtain the best possible energy performance. Some of the basic findings are as follows:

- **Climate**: The HSG glazing provides the best overall performance in locations with more than 3,000 heating degree-days, which includes nearly all locations in Canada. The higher the cost of heating, the greater the benefit from reducing the heating loads through the use of HSG windows. However, in locations where cooling dominates (such as the southern U.S.), LSG glazing produces greater savings in energy costs.
  If air conditioning is used, test results showed that shading on the exterior through the use of shutters or shades can reduce cooling energy consumption on sunny days by up to 26%. When a house is operated without air conditioning, HSG glazing should still be selected for heating-dominated climates because of the beneficial effect of winter solar gains and reduced heating energy consumption.
- **Combinations of glazing and orientation**: Even greater energy savings can be achieved by strategically locating glazing. In a heating-dominated climate, HSG glazing should be used on the south side to maximize solar gain. Glazing on the north side of a house should be selected based on thermal performance (i.e., a low U-factor). If more than one type of glazing is used, care is needed to ensure correct window placement during construction.
- **House temperature**: On sunny winter days, temperatures in the south-facing rooms of the CCHT research house were found to be up to 3.8°C warmer at mid-height in rooms with HSG glazing than in the rooms with LSG glazing. The difference was much less (1°C) in summer due to the higher position of the sun. Both types of low-e glazing allowed less solar gain than clear glass.
- **Shading**: Shading experiments at CCHT showed that standard Venetian blinds used on the interior had little effect on reducing summer cooling energy consumption. However, exterior shading reduced cooling consumption on sunny days by up to 26%. This can be accomplished through the use of shades or shutters, overhangs that shade windows in summer and allow solar gains in winter, or strategically placed deciduous trees.

Summary

When all is considered, for the heating-dominated locations that typify Canada, the most energy- efficient deployment of windows is the use of HSG windows in locations where there is exposure to winter sunshine and using shading to limit solar heat gain in the summer. On the north side of a residence, glazing with a high insulating value (low U-factor) should be used to minimize conductive heat loss in winter.☼

For more information, refer to the new NRC-IRC publication, Construction Technology Update No. 71, ***Selecting Residential Window Glazing for Optimum Energy Performance****, available at: http://irc.nrc-cnrc.gc.ca/pubs/ctus/index_e.html*

The Canadian Centre for Housing Technology (CCHT) is jointly operated by the National Research Council, Natural Resources Canada, and Canada Mortgage and Housing Corporation.

CHBA Builders Manual

CHBA has updated its residential construction reference book.

The new edition of the CHBA Builders' Manual has been updated. It is based on the building techniques proven by R-2000, offers over 400 pages of concise information and easy-to-follow illustrations. Included in this edition are an expanded section on renewable energy and a new section on home automation.

CHBA Builders' Manual
Canadian Home Builders' Association
150 Laurier Avenue West, Suite 500
Ottawa, Ontario K1P 5J4

Telephone: 613-230-3060
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www.buildermanual.com

Basement Wall Insulation Retrofit Monitoring Study

Getting basement details right is a challenge. CMHC has a project underway to test the performance of several basement wall insulation systems in a number of houses, representing a range of housing types. The intent of the study is to capture basements with a variety of conditions, from dry to near-wet, and also to include several types of foundation wall types (rubble masonry, concrete block, poured concrete).

The research will monitor different basement walls side-by-side in the same house (e.g. standard frame walls with and without polyethylene), and see whether any are better. Basement conditions will be monitored as well as the temperature and moisture conditions inside the test walls, and the wood moisture content in any framed alternatives.

It is hoped that the project will develop guidelines that will help builders, consumers, and designers understand what basement wall insulation systems are appropriate for basements in older homes. The results will also assist builders and designers with basement construction details for new homes.☼

Energy Answers

Rob Dumont

How important is it to make sure that solar collectors on a house are not shaded by trees?

Before I answer that, let me talk in general about the importance of solar energy.

It is easy to overlook the importance of the sun, given the use of artificial lighting and windowless office spaces these days.

It is well, on the other hand, to remember that life on earth would not be possible without solar energy. The sun's energy heats up the earth from -273°C to an average year-round temperature of about 15°C. Every person on this planet lives in a solar-heated environment.

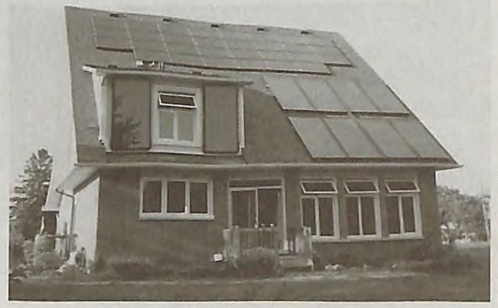
All of our major energy sources – oil, coal, natural gas, propane, wood, other biomass, even wind power – are derived from the sun. It is only geothermal energy, nuclear energy, and tidal energy (which is driven by the moon) that are not directly driven by the sun.

Virtually all of our food production is dependent on the photosynthesis process supplied by energy from the sun.

The sun also directly affects human health. According to the health people, the sun's rays help Vitamin D production in our bodies and regulate our circadian rhythms. People who work graveyard shifts and basically have to ignore solar radiation are more prone to cancers.

In November 2008, I attended a very important conference sponsored by Canada's National Research Council on the topic of Buildings and Health. One of the speakers, Ted Kesik, of the University of Toronto spoke on the fundamental importance of designing sustainable (i.e., solar energized) buildings. In his outstanding talk he quoted Norman Foster, perhaps the most famous architect in the world, as follows: "Solar architecture is not a matter of fashion. It is a matter of survival."

The attached picture shows a 2008 view of the solar panels on the Minto Inspiration Demonstration Home in Manotick, Ontario. The house is part of the EQuilibirum Net Zero Healthy Homes project sponsored by CMHC. The house uses three types of solar panels – photovoltaic panels on the upper part of roof, active solar thermal panels on the right hand side of the roof, and vertical solar air heating panels on the sides of the dormer window. The solar air heating panels preheat air for the heat recovery ventilator (air-to-air heat exchanger). The roof is sloped at a tilt angle to the horizontal of 45 degrees, and Ottawa is at a latitude of 45 degrees. And, of course, the house uses passive solar gain for some space heating.



R. Dumont photo credit

Figure 1. Minto Inspiration Home, Manotick, Ontario One of the CMHC EQuilibrium Net Zero Energy Healthy Homes http://www.minto.com/ecohome/vtour.asp

Anything that obstructs solar energy from reaching solar panels should be vigorously avoided. Solar panels are not cheap, and the panels must receive full sun for them to function to their full potential. Fortunately, the movement of the sun through the sky can be predicted with precision, and this knowledge can be used to help avoid obstructions that reduce the amount of energy reaching solar panels.

Let's start by reviewing how the sun moves through the sky. On September 21 and March 21, every location on this planet receives 12 hours of daylight and 12 hours of darkness. The sun rises directly in the east and sets directly in the west on those days. Figure 2 shows how the sun moves relative to a house on that day. (Yes, I do know that the sun does not move; it is the earth that rotates, however, I suspect that a lot of people do not know that simple fact. In addition, it is a lot easier to explain if you consider that the sun moves relative to the earth.)

As can be seen from the diagram, the sun is above the horizon for 12 hours on those days, which are also known as the fall and spring equinoxes.

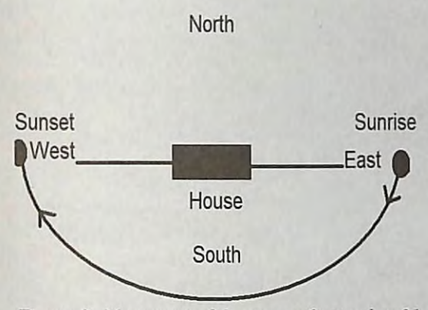


Figure 2. Movement of the sun on September 21 and March 21

On the shortest day of the year in the northern hemisphere (December 21), the sun is up for less than 12 hours. The further north you go at that time of the year, the fewer hours of sunlight that are available. Above the Arctic Circle (latitude 66.5 degrees north) on December 21, the hours of daylight are zero. One winter I was working in Aklavik in the Northwest Territories, and can attest that there is essentially no daylight at that time of the year. (There was only a small bit of twilight around noon).

Here in Saskatoon, at latitude 52 degrees north, the sun is up only for about 7 hours on December 21. A diagram showing the sun's path at that time of the year is shown in Figure 3.

On June 21, the sun in the northern hemisphere is up for a much longer time. In Saskatoon the sun is up for about 17 hours a day. A diagram showing the sun's path on that day is shown in Figure 4.

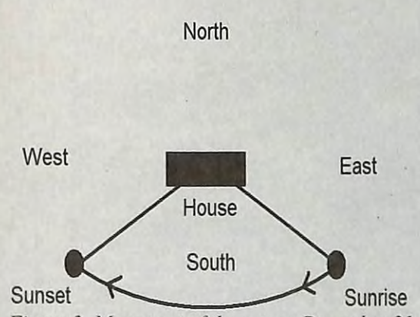


Figure 3. Movement of the sun on December 21 relative to a south facing house located at 52 degrees North latitude.

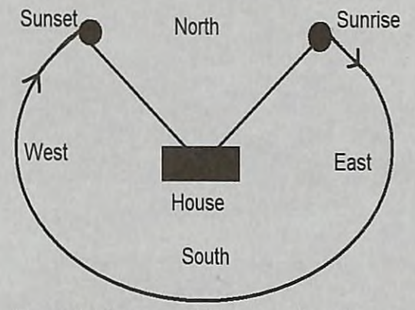


Figure 4. Movement of the sun on June 21 relative to a south-facing house at latitude 52 degrees North.

In almost all climates and locations on earth, fixed solar panels should face the equator at a tilt angle from the horizontal equal to the latitude. The Minto home near Ottawa follows this prescription. In my home in Saskatoon (Figure 5), we are further north at 52 degrees latitude. Fortunately, there is some variation allowed in the tilt angles. Thus for my own house I tilted the active solar thermal panels at an angle of 70 degrees to the horizontal to favour the winter sun, when I need it the most. A tilt angle equal to the latitude angle plus or minus 20 degrees should be close to optimum in most locations.

Figure 5. Solar thermal panels on the Dumont Residence. Note the elm trees on the west side, and their reflection in the solar panels.

For fixed solar panels, the hours around solar noon are the critical ones for gathering useful solar energy. For most tilted solar panels, the hours between about 8 a.m. and 4 p.m. (4 hours on either side of solar noon) are the crucial times for gathering solar energy. Any obstructions such as tree branches, adjacent buildings, or tall shrubs will adversely affect the useful solar energy. The higher up on the roof or wall that you can mount the solar panels, the better in terms of improving solar access. If you look at the picture of the Minto Inspiration House,

you will notice that the photovoltaic panels are located higher on the roof than the active solar thermal panels. This makes good sense for two reasons. Electricity is generally worth much more than thermal energy. And in Ontario, the electricity generated by the PV panels is worth 42 cents per kilowatt-hour, or about 8 times as much as the energy from natural gas.

Note in the photo of the Minto house that there is some shading of the active solar thermal panels from the shed dormer. This picture was taken late in the afternoon of August 20, 2008, well past 5 p.m. Thus the amount of solar energy lost by the shading is small. Wisely the designers placed the active solar thermal panels as far away as they could from the shed dormer. Note, however, that there is a reflection of some trees in the glass of the solar air heating panels. Trees can grow very tall, and these trees can be a problem. On my own home this fall I had to cut down some branches that were growing on the elm trees on the west side, blocking the late afternoon sun.

The sun needs no maintenance, but trees blocking the sun do.

A number of solar home books suggest putting deciduous trees on the south side of houses, and evergreens on the west, north and east sides. The reasoning is that the deciduous trees will lose their leaves in the heating season. The problem with this approach is that the deciduous tree branches can still obstruct the solar panels in winter. Solar energy is precious and trees get in the way. Keep deciduous trees away from the south side of your home. Regular pruning is also a must with any tree that could obstruct solar panels.☼

Solplan Review Back issues

A limited number of back issues are available, at a special price of $5.75 each (plus 6% GST).

Bundle special: a random selection of back issues (minimum 22 copies) are available for only $65.00 (plus 6% GST)

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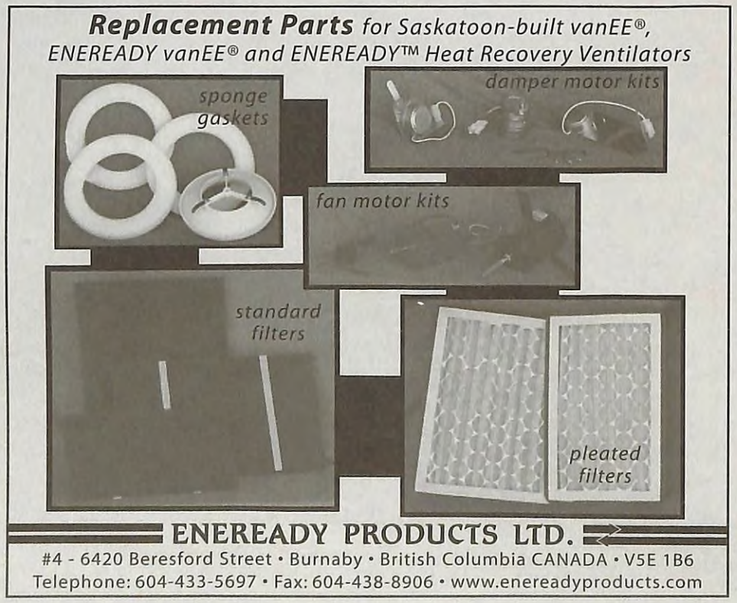
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RenoMark™

The Canadian Renovators Council has recommended the national endorsement of the BILD initiated RenoMark™ initiative for renovators.

The RenoMark™ is a marketing program that enhances and identifies professional renovation contractors who have agreed to a Code of Ethics as well as a renovation-specific Code of Conduct. It was developed and launched by BILD (formerly the Greater Toronto Home Builders' Association in 2001.

RenoMark™ renovators are professional contractors who provide warranties, who understand the value of customer service during and following projects, and who have access to information on curent trends, the latest materials and new regulations. They have agreed to abide by the following:

* Be a member in good standing of the local endorsing association. (The program has been endorsed by 16 associations in 5 provinces).
* Abide by the code of ethics.
* Provide a detailed, written contract (including scope of work) for all jobs.
* Offer a minimum two-year warranty on all work (excludes minor home repair).
* Carry a minimum of $2 million liability insurance.
* Have coverage for workplace safety and employers' liability and/or work only with subcontractors who carry such coverage.
* Carry all applicable licenses and permits.
* Maintain a professional level of knowledge of current building codes, permit procedures, and technical skills through continuing education.
* Maintain a safe and organized worksite.
* Return phone calls within two business days.

Information: *www.renomark.ca*

Gas Barbeque Recall

Barbeque season may be over in most of Canada, however, you should be aware that CSA International and Fiesta Barbeques of Brampton, Ontario, have announced a voluntary recall to inspect and repair gas grills. There may be an assembly problem with gas hoses in some "Blue Ember Gas Grills". This safety notice involves Blue Ember brand liquid propane (LP) or natural gas outdoor barbeques, Models FG50057 and FG50069. Approximately 34,000 units were distributed across Canada.

The barbeques may be assembled improperly exposing the burner hoses to excessive heat, and may pose a fire and burn hazard to users. They have received 16 reports of barbeque fires in Canada that may have been caused by the burner hose being placed behind the heat shield.

The model and serial numbers are printed on a rating plate label on the rear of the grill. The barbeques were sold nationwide at various home centres and retailers from November 2007 through June 2008.

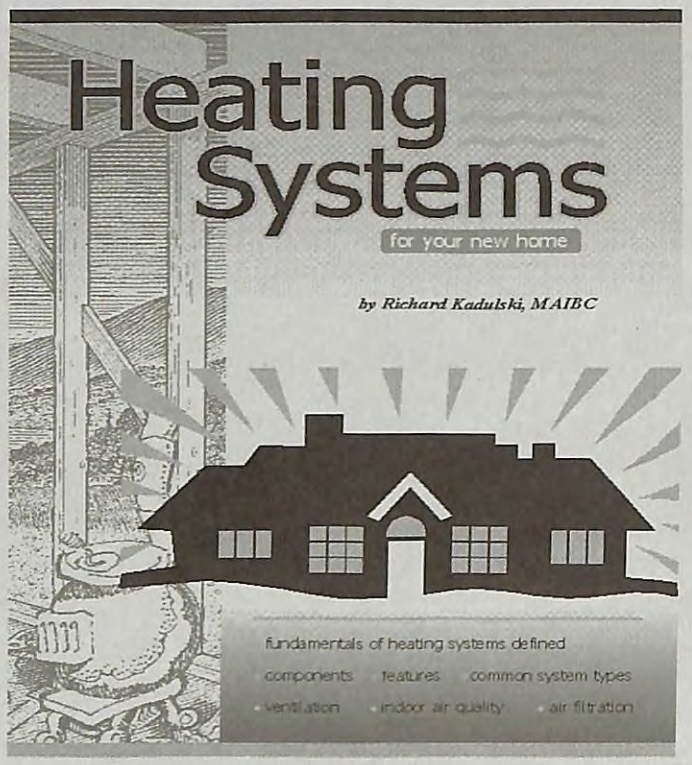
For additional information, contact Fiesta toll free: 1-866-956-0396 (7 am to 5 pm Eastern, Mon-Fri) or *www.blueembergrills.com*, or email *lnguyen@fiestabbq.com.*

Did You Know: about moisture sources on a job site

Significant amounts of moisture are generated by many trades during construction.

- A 4" thick concrete floor slab poured in an enclosed building generates 1 ton of water per 1000 square feet of concrete.
- Each 200-pound tank of propane burned by a propane heater (to provide temporary heat) generates 30 US gallons (113 liters) of water.
- Oil-burning heaters produce 1 gallon of water for every 1 gallon of oil burned.
- Paint, plaster, drywall and other water-based construction materials contribute large quantities of construction-generated moisture.

When proper measures are not taken, construction-generated moisture can contribute to high levels of relative humidity inside the structure. When the outside temperature drops, condensation can form on any cold surface, which is why you may see frost inside the house during construction, including the inside surface of windows and skylights, uninsulated portions of decks, roof insulation or the underside of the roof sheathing.☼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